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ORIGINAL PAPER

Effect of Enzymatic Hydrolysis on Structural, Chemical and Elemental Properties of Sweet Potato Flour

Suman Jagatee[1] · Jyoti Ranjan Rout[2] · Shuvashish Behera[3] · Shidharth Sankar Ram[4] · Mathummal Sudarshan[5] · Chinmay Pradhan[1] · Santi Lata Sahoo[1] · Rama Chandra Mohanty[1]

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Abstract

In the present study, the structural, chemical and elemental changes of sweet potato flour after hydrolysis by α-amylase (liquefaction) and a mixture of α-amylase and glucoamylase (saccharification) were investigated. Thin layer chromatography (TLC), high performance liquid chromatography (HPLC), scanning electron microscopy (SEM), fourier-transforms infrared spectroscopy (FTIR) and energy dispersive X-ray fluorescence spectrometry (EDXRF) were used to study the properties of the hydrolyzed sweet potato starch. Efficient hydrolysis was evidenced from both TLC and HPLC that the thermostable α-amylase was able to yield the simple forms of sugar such as glucose, fructose, maltose and maltotriose whereas, only glucose is depolymerized after the combined effect of α-amylase and glucoamylase. SEM analysis of raw, liquefied and saccharified sweet potato root flour (SPRF) showed the various porous starch granules with a high degree of structural changes in saccharified samples in comparison to others, which indicates the active involvement of tested the enzymes. The saccharified SPRF were fermented by *Saccharomyces cerevisiae* and *Zymomonas mobilis* separately and the results confirmed that *Z. mobilis* was able to produce more stretching vibration of –OH than *S. cerevisiae*, suggesting better production of bioethanol. In addition, the elemental analysis was carried out to evaluate the impact of *S. cerevisiae* and *Z. mobilis* with respect to elemental constituents. The results of the elemental analysis showed increase in the concentrations of S, Cl, Ca, Mn, Fe and Zn and decrease in the concentrations of P and K in the fermented residue of *S. cerevisiae* and *Z. mobilis*, however more variation was observed in *Z. mobilis*.

✉ Jyoti Ranjan Rout
routjr@aiph.ac.in; routjr@gmail.com

Suman Jagatee
suhanisuman.in@gmail.com

Shuvashish Behera
behera.shuvashish@gmail.com

Shidharth Sankar Ram
tracebio@gmail.com

Mathummal Sudarshan
sude@alpha.iuc.res.in

Chinmay Pradhan
chinmay.uubot@gmail.com

Santi Lata Sahoo
santi_bot_uu@yahoo.co.in

Rama Chandra Mohanty
mohantyrc62@gmail.com

1 Microbiology Laboratory, Post Graduate Department of Botany, Utkal University, Vani Vihar, Bhubaneswar, Odisha 751004, India

2 School of Biological Sciences, AIPH University, Bhubaneswar, Odisha 752101, India

3 Alcohol Technology & Biofuels Vision, Vasantdada Sugar Institute, Manjari Budruk, Pune 412307, India

4 Institute of Physics, Bhubaneswar, Odisha 751005, India

5 UGC-DAE Consortium of Scientific Research, Kolkata Centre, Bidhan Nagar, Salt Lake, Kolkata 700098, India

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Tropical Plant Pathology

ORIGINAL ARTICLE

Genetic variation and survival of *Erysiphe necator* in tropical India

Shashikant B. Ghule[1,2] · Indu S. Sawant[1] · Sanjay D. Sawant[1] · Sujoy Saha[1] · B. M. Devarumath[3]

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Abstract

The heterothallic, biotrophic fungus *Erysiphe necator* causes powdery mildew on grapes which impacts the yield and quality of fruits and their processed products. Two genetic groups, A and B, have been described which overwinter either as flag shoots or chasmothecia. The genetic structure of the Indian isolates and their oversummering mode in tropical regions is not known. In this study, population genetic analysis of 26 and 134 *E. necator* isolates from temperate and tropical regions of India, respectively, was performed. PCR analysis showed presence of both genetic groups A and B in temperate regions and only genetic group B in tropical regions. Flag shoots were not observed in tropical region. Weather data analysis and temperature sensitivity of *E. necator* conidia indicate the possibility of the pathogen oversummering as conidia on bark. Sequence analysis of *ITS* (Internal Transcribed Spacer), *IGS* (Intergenic Spacer), *TUB2* (Beta-Tubulin) and *EF1-α* (Translation Elongation Factor 1-α) genes covering 1762 nucleotides from 22 isolates showed the presence of four haplotypes, A-IN1, B-IN1, B-IN2 and B-IN3 in temperate regions and only haplotype B-IN3 in tropical regions. Haplotypes A-IN1 and B-IN1 were similar to haplotypes of group A and B, respectively, reported from USA, Europe and Australia. The other two haplotypes, B-IN2 and B-IN3 grouped with haplotypes from USA and are new reports from India. The diversity and haplotype structure suggest that powdery mildew was introduced in north India and then moved to tropical regions corroborating historical reports of the introduction of grapevines in India. Occurrence of a genetic group with lower fungicide sensitivity and greater aggressiveness might explain the difficulties to manage this disease in Maharashtra, India.

Keywords Flag shoot · Genetic diversity · Grapevine · Haplotype · Powdery mildew

Introduction

The commercially grown *Vitis* cultivars are highly susceptible to powdery mildew and severe crop loss can occur if favorable weather conditions prevail during the susceptible growth stages of the vine. Powdery mildew is caused by the biotrophic ascomycete fungus, *Erysiphe necator* (Schw.) (earlier *Uncinula necator* [Schw.] Burr.; anamorph *Oidium tuckeri*) (Braun and Takamatsu 2013). The pathogen is specific to *Vitis* species, but may also occur on species within *Parthenocissus* and *Ampelopsis* (Boeswinkel 1980). *E. necator* is a heterothallic fungus known to propagate both asexually and sexually (Gaudoury and Pearson 1991).

Study of the genetic diversity and population structure of *E. necator* has been limited due to its obligate and biotrophic nature (Stummer et al. 2000). Studies were performed using molecular methods for detection of point mutations in the *CYP51* and β-tubulin genes, microsatellites, RFLP (restriction fragment length polymorphism), AFLP (amplified fragment length polymorphism), RAPD (random amplified polymorphic DNA), SCAR (sequence characterized amplified region) and transposons analysis (Delye et al. 1999; Stummer et al. 2000; Hajjeh et al. 2005; Amrani and Corio-Costet 2006; Nunez et al. 2006; Bousceaut and Corio-Costet 2007). All these studies described two genetic groups or biotypes, A and B,

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✉ Indu S. Sawant
indulikal8@yahoo.co.in

[1] ICAR - National Research Centre for Grapes, Manjri Farm, Pune, Maharashtra 412 307, India

[2] Registered with Savitribai Phule Pune University for Ph.D. degree, Pune, Maharashtra 411 007, India

[3] Vasantdada Sugar Institute, P.O. Manjri Farm, Pune, Maharashtra 412 307, India

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Gamma radiation degradation of chitosan for application in growth promotion and induction of stress tolerance in potato (Solanum tuberosum L.)

Abhijeet B Muley [1], Prashant R Shingote [2], Ajit P Patil [1], Sunil G Dalvi [3], Penna Suprasanna [4]

Affiliations + expand

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Abstract

Oligo-chitosan (82.20 kDa) was prepared from chitosan (337.73 kDa) by application of 100 kGy γ-irradiation. UV-vis spectroscopy, FTIR, XRD, DSC and TGA analyses showed typical properties of chitosan with slight variations after γ-irradiation. Degree of deacetylation of chitosan and oligo-

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

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ORIGINAL PAPER

Isolation and identification of three new mycoparasites of *Erysiphe necator* for biological control of grapevine powdery mildew

Shashikant B. Ghule[1,2] · Indu S. Sawant[1] · Sanjay D. Sawant[1] · Sujoy Saha[1] · R. M. Devarumath[3]

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Abstract
Powdery mildew causes significant yield and quality loss in grapes. Disease management includes fungicides belonging to the demethylation inhibitor and quinone outside inhibitor groups which are associated with development of fungicide resistant pathogen populations and detection of fungicide residues at harvest. This study was conducted to identify potential antagonists which can be used solo or in integration with safer chemical. Three mycoparasitic fungi were isolated and evaluated for parasitism and biocontrol. Light and scanning electron microscopic analysis showed that the hyphae of mycoparasites grew over the powdery mildew colony forming a mycelial web over it, coiled around the conidiophores and conidia of *E. necator*, penetrated the conidia and caused their total collapse. Based on molecular identification, the mycoparasites were identified as *Lecanicillium antillanum*, *Acremonium sclerotigenum* and *Sarocladium terricola*. All three isolates were positive for production of β-1-3 glucanase, cellulase, chitinase, protease, amylase and lipase which are involved in bio-control mechanism. During pot, nursery and vineyard trials all the isolates consistently showed powdery mildew reduction and achieved 41.76% to 65.61% disease reduction. *Sarocladium terricola* was more effective in all the trials. All three mycoparasites were compatible with chitosan and sulfur and alternate applications of mycoparasites with these two safe chemicals, the efficiency of *L. antillanum*, *A. sclerotigenum* and *S. terricola* was increased by 20.16, 27.33, and 8.94% respectively on leaves and 20.85, 21.36, and 16.06% respectively on bunches as compared to their solo applications. The study introduces new possibilities for control of grape powdery mildew using safer alternatives.

Keywords *Sarocladium terricola* · *Lecanicillium antillanum* · *Acremonium sclerotigenum* · Biological control · Powdery mildew · Mycoparasitism

Introduction

Grape is a commercially important fruit crop for India and is mainly cultivated for consumption as fresh fruit, and value-added products such as raisin and to some extent wine and juice. Commercial cultivation of grapes is mainly concentrated in the state of Maharashtra which accounts for more than 75 % of the grape area and 80 % of total production (nhb.gov.in/PDFViwer.aspx). In Maharashtra and other areas in the north and south India, the grape is highly vulnerable to different diseases among which powdery mildew is a major problem. It is caused by the obligate, ascomycetes fungus *Erysiphe necator* Schw. (formerly *Uncinula necator* (Schw.) Burr.) and is favored by warm, humid and cloudy weather (Pearson 1988). *Erysiphe necator* does not reproduce sexually in tropical India due to the presence of only one mating type, *MAT 1–2* (Sawant et al. 2015), and it also does not form flag shoots in this region. It over-summers only through the conidia. In the tropical peninsular region due to the presence of conducive warm, humid climatic conditions and availability of susceptible host tissues, powdery mildew is present for most part of the year (Sawant et al. 2015). Severe foliar infections impact

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✉ Indu S. Sawant
indulika18@yahoo.co.in

[1] ICAR-National Research Centre for Grapes, P.O. Manjri Farm, Pune, Maharashtra 412 307, India

[2] Registered with Savitribai Phule Pune University, Pune, Maharashtra 411 007, India

[3] Vasantdada Sugar Institute, P.O. Manjri Farm, Pune, Maharashtra 412 307, India